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AUTHOR Higgins, Mary Anne
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ABSTRACT

This paper begins by providing a thorough history and review of the diffusion of innovations research tradition. It then focuses on undesirable, indirect, and unanticipated consequences of innovations based on the dominant paradigm of development. In the case of high-input agriculture, the consequences have affected the quality of the environment and the food supply; they have also damaged the credibility of change agents and detracted from the ability of conventional farmers to adapt to sustainable farming practices. The paper suggests that the diffusion of innovations like sustainable agriculture be based on an alternative paradigm of development and a communication-centered model of research. Contains 40 references. (Author/NKA)

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The Communication of Innovations and the Case of Sustainable Agriculture

Mary Anne Higgins

Department of Communication

Indiana-Purdue University Fort Wayne

Fort Wayne, IN 46805-1499

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Abstract

The Communication of Innovations and the Case of Sustainable Agriculture begins by providing a thorough history and review of the diffusion of innovations research tradition. It then focuses on undesirable, indirect, and unanticipated consequences of innovations based on the dominant paradigm of development. In the case of high-input agriculture, the consequences have affected the quality of the environment and the food supply. They have also damaged the credibility of change agents and detracted from the ability of conventional farmers to adapt to sustainable farming practices. The paper suggests that the diffusion of innovations like sustainable agriculture be based on an alternative paradigm of development and a communication-centered model of research.

The Communication of Innovations and the Case of Sustainable Agriculture

Introduction

In 1943, Ryan and Gross articulated a model of diffusion of innovations research when they published an article in Rural Sociology about the adoption of hybrid seed corn (Rogers, 1995). More than 50 years later, Rogers reported that more than 3,900 diffusion studies had appeared in print. Although diffusion research is well represented by the communication discipline, it is best represented by rural sociology. In 1995, Rogers reported that rural sociologists had published 847 diffusion studies, while communication scholars had published 484.

The paradigm of diffusion research established by rural sociologists, however, has recently been challenged. Critics contend that it is based on a "dominant paradigm of development" (Rogers, 1983, p. 121). They charge that the dominant paradigm's

assumptions are inconsistent with the goals of some non-technological innovations like conservation. Consequently, scholars in the United States and developing nations have advocated that diffusion research accommodate an alternative paradigm (Bordenave, 1976; Rogers, 1995; 1983).

In this article, an exemplary literature review explains the key elements of diffusion research. It also demonstrates that the research model employed by rural sociologists and scholars in other disciplines is inappropriate to the study of non-technological innovations that improve the quality of life but do not advance the use of technology. The project concludes by suggesting that communication scholars examine environmental, conservation, and other non-technological innovations from a communication of innovations perspective.

Review of Literature

In rural sociology, the tradition of diffusion of innovations research began in 1943 when Ryan & Gross studied the diffusion of hybrid seed corn in two Iowa communities. After Iowa State University developed

hybrid seed corn, the Iowa Agricultural Extension Service and seed companies made it accessible to farmers in 1928 (Rogers, 1995). Some Iowa farmers adopted the innovation and enjoyed the many advantages hybrids held over open-pollination. Even though the hybrid seeds improved corn yields, drought resistance, and suitability for mechanical harvesting, other farmers waited until 1941 to adopt the innovation. According to Rogers, their 13-year hesitation perplexed researchers at the experiment station. They were quick to fund Ryan's research proposal on the diffusion of hybrid seed corn.

Elements of Diffusion of Innovations Research

Ryan & Gross (1943) studied the communication channels used to communicate ideas related to the innovation of hybrid seed corn. They also examined the elements of time and the social system. They found that the most influential factor in the farmer's decision to adopt the innovation was the peer network. As Rogers (1962) noted, future diffusion studies examined the four elements central to the Ryan & Gross study: (1) the innovation, (2) which is communicated via certain channels, (3) over time, (4) among the members of a

social system.

The innovation.

Individual perception determines the characteristics of innovations (Rogers with Shoemaker, 1971). Adoption rates increase as the degree of perceived advantage, compatibility, trialability, and observability increases. Individuals decide to adopt innovations that hold social or economic benefits, are consistent with prevailing values and norms, permit sampling or experimentation, and yield visible results. A fifth perceived attribute, complexity, may decrease adoption rates. Innovations which require adopters to learn new skills diffuse more slowly than those which do not.

Communicated via certain channels.

Communication channels are the means by which a new idea is transmitted from an inventor or source to a potential adopter or receiver. Mass media channels are the most efficient means of communicating information about an innovation, whereas interpersonal channels are the most effective means of influencing its adoption (Copp, Sill, & Brown, 1958). The source's choice of

communication channels is based on the time dimension.

Communicated over time.

Time, the third element of diffusion, is a central component of diffusion concepts. The first concept, the innovation-decision process, is comprised of cumulative stages (Emery & Oeser, 1958; Lavidge & Steiner, 1961). Although researchers have disagreed on the number of stages, a synthesis by Rogers with Shoemaker (1971) yielded four distinct stages. The knowledge stage occurs when an individual is exposed to information about an innovation. During the second stage, persuasion, an individual forms a positive or negative attitude toward the innovation. An individual adopts or rejects the innovation during the decision stage. The fourth stage, confirmation, occurs when the individual continues or discontinues the use of the innovation.

Time is also the basis for the concepts of adopter categories (Rogers with Shoemaker, 1971) and rate of adoption (Lionberger, 1960). Relative to the other members of a social system, an individual's innovativeness places him or her into one of five adopter categories: innovators, early adopters, early majority,

late majority, and laggards. Rate of adoption is measured by the time required for a certain percentage of members of a system to adopt an innovation.

Communication among the members of a social system.

Rogers with Shoemaker (1971) defined a social system as a group of units which are functionally differentiated but mutually engaged in goal attainment. Residents of a rural community can be differentiated from each other, but they all share certain group objectives, such as economic growth and a safe environment. System influences can affect an individual's decision to adopt or reject an innovation. Traditional social systems, which are not receptive to change, discourage an individual's adoption of an innovation. Modern social systems, which are receptive to change, encourage an individual's adoption of an innovation (Davis, 1959).

Individuals within the social system may also perform key roles in the diffusion process. Opinion leaders are credible members of a social system who can influence the opinions of other members of the system (Copp, Sill, & Brown, 1958; Katz, 1957; Lazarsfeld, Berelson, & Gaudet, 1944; 1968). As Copp, Sill, and

Brown suggested in 1958, the influence of this interpersonal channel of communication is more persuasive than the influence of media channels. Although opinion leaders are usually members of a social system, change agents are professional representatives of a change agency external to the system (Rogers with Shoemaker, 1971). They may enlist the aid of opinion leaders in influencing members of a social system to adopt or reject innovations.

"The Diffusion of Hybrid Seed Corn in Two Iowa Communities" (Ryan & Gross, 1943) advanced a research model that became a revolutionary paradigm (Kuhn, 1970) in rural sociology. Rogers (1995) noted that the new model attracted young scholars who wished to foster the paradigm's development or disprove some of its elements. Their shared intellectual interest built a strong tradition of diffusion research in rural sociology and contributed to the research traditions of other disciplines, including communication.

A Research Revolution in Rural Sociology

Rogers (1995) credited scholars at the University of Wisconsin, the University of Missouri, and Iowa state

University with pioneering the diffusion of innovations tradition in rural sociology. He and other graduates of the universities promoted diffusion research where they began their teaching careers. Rogers, who graduated from Iowa State, taught at Ohio State University. He noted that two cliques dominated the invisible college formed by diffusion scholars. Each clique revolved around one leading scholar whose personal network extended to former proteges and their students.

Scholars who were attracted to the diffusion paradigm formed an invisible college (Rogers, 1995) or a cohesive network of scholars. Their research focused on the theory and methodology of diffusion of innovations. Their progress was orderly, cumulative, and directed toward the same goals. They studied similar subjects and their preceding investigations influenced successive inquiries. During the 1950s and 1960s, as these scholars built upon each other's research, the tradition of diffusion research in rural sociology experienced rapid growth.

Research funding, according to Rogers, was also a factor in the rise of diffusion studies in rural

sociology. As the "research revolution" was underway in rural sociology, an "agricultural revolution" (Rogers, 1995, p. 56) was taking place on the nation's farms. During the 1950's the United States Department of Agriculture (USDA) and state experiment stations produced agricultural innovations such as new farm equipment and chemical pesticides. The USDA and other agencies provided grant dollars to study the diffusion of new technologies that increased the farmer's productivity. Spiraling adoption rates boosted yields-per-acre. The number of people that the average farmer fed and clothed jumped from 14 to 26 between 1950 and 1960. By 1970, the average farmer produced enough food and fiber for 47 people.

As a result of the research and agricultural revolutions, the number of published diffusion studies by rural sociologists increased from 185 in 1960 to 648 by 1970. In the 1970s, the number of replications increased, precisely because researchers had proven the model's explanatory power. As the number of original studies decreased, the tradition of diffusion research in rural sociology began its decline.

Changing agricultural conditions also played a role in the tradition's decline (Rogers, 1995). Farmers who adopted innovations like fertilizers, hybrid seeds, pesticides, and machinery increased their production. Higher yields per acre led to lower commodity prices, decreased farm profits, and surpluses in production. Policymakers viewed overproduction as a problem, one that would only be aggravated by continued diffusion of innovations research.

The Research Tradition in Communication

In the first edition of Diffusion of Innovations, published in 1962, Rogers did not regard communication as a research tradition because communication scholars had published only 1% of diffusion studies. At that time, Rogers (1994) noted that the young discipline was just beginning to reflect the influence of The Mathematical Theory of Communication by Claude E. Shannon and Warren Weaver (1949). Shannon & Weaver's scientific approach to the study of human communication was adopted by new schools and departments of communication that offered doctoral programs. As the new Ph.D.'s began their teaching and research careers, the scientific perspective

spread to other universities (Rogers, 1995).

In the 1980s, communication scholars began to establish a strong diffusion tradition. Rogers (1995) stated that Deutschmann & Danielson's (1960) study on news diffusion inspired other scholars to track the flow of information about major news events (DeFleur, 1987; Greenberg, 1964; Mayer, Gudykunst, Perril, & Merrill, 1990). Rogers also cited Deutschmann's (1962) investigation of the diffusion of innovations in a Colombian village as a landmark investigation of technical innovations introduced in the Third World nations.

During the next two decades, researchers examined the adoption of technological innovations in the United States. In the 1970s, the focus shifted from the adoption patterns of individuals to the adoption patterns of communities, organizations, and other groups (Bach, 1989; Van de Ven, Angle, & Poole, 1989; Van de Ven & Rogers, 1988). In the 1980s, communication scholars continued to build the research tradition as they studied the diffusion of communication technologies (Ettema, 1989; Greenberg, 1989; Steinfield, Dutton, & Kovaric,

1989).

Research Traditions in Other Disciplines

As members of other disciplines became familiar with the diffusion of innovations model described by Ryan & Gross (1943), an innovation communicated via certain channels over time became the focus of studies in several disciplines. According to Rogers (1995) major research traditions were established in education, public health and medical sociology, marketing, geography, general sociology, and general economics. Minor research traditions also developed in public administration, political science, agricultural economics, psychology, statistics, and industrial engineering.

As the major and minor research traditions evolved, the unit of analysis in diffusion studies ranged from the educator to the physician. Researchers in education surveyed administrators and teachers to study the adoption rate of team teaching (Miles, 1964), modern math (Mort, 1953), and other innovations. Medical sociologists from Columbia University analyzed the diffusion of a new antibiotic among physicians (Coleman, Katz, & Menzel, 1957). Using objective measures from

pharmacy records to chart the time of adoption, the researchers found that, once the opinion leaders decided to prescribe the antibiotic, other doctors quickly followed suit.

By 1994, marketing had contributed 585 or 15% of the 3,890 diffusion publications. Of the major research traditions noted above, marketing made the largest contribution with 15 percent or 585. The publication contributions of the other traditions include education with 9 percent or 359, general sociology with 8 percent or 322, public health and medical sociology with 7 percent or 227, general economics with 5 percent or 155, and geography with 4 percent or 160.

Few of the diffusion studies published in rural sociology and other disciplines examined the consequences of innovation. Most research questions examined the process of diffusion instead of the effects (Skill, 1993). Although Rogers (1983, 1995) and Skill both called for more research into this area, they both acknowledged the difficulty of undertaking studies addressing the effects of innovations.

Consequences of Innovation

According to Rogers (1995) pointed out, the study of consequences of innovations has been neglected. Skill (1993) cited four factors that have limited the examination of diffusion effects: 1) It is difficult to track consequences that generally occur over a long period of time; 2) Sponsors of diffusion investigations are inclined to view the consequences of diffusion as positive. Rogers (1994) referred to this assumption as a pro-innovation bias; 3) Identifying one particular effect is often difficult because it may have been mixed with other changes; and 4) Evaluating positive or negative consequences is subject to personal, subjective or cultural biases.

Despite the above limitations, Skill (1993) and Rogers (1995) emphasized the importance of assessing the impact of innovations. Rogers divided innovations into three areas: desirable and undesirable consequences, direct and indirect consequences, and anticipated and unanticipated consequences.

Desirable and undesirable consequences.

The definition of desirability is based on how the innovation affects the individual or social system who

has adopted the innovation (Rogers, 1995). Desirable consequences are functional effects, whereas undesirable consequences are dysfunctional effects.

An innovation may have a functional impact on a system and a dysfunctional impact on individuals. As an example, Rogers (1995) cited the adoption of corn and wheat varieties in India and other countries that contributed to the Green Revolution. The revolution, although it resulted in higher production levels and greater farm income, also drove some small farmers out of business.

Due to the nature of technological innovations, the consequences of their diffusion usually result in socioeconomic changes within a social system. These changes have a desirable effect on some individuals and an undesirable effect on others. Like the Green Revolution, the classic hybrid seed study (Ryan & Gross, 1943) widened a socioeconomic gap between the wealthy and the poor. In a re-analysis of the study, Rogers (1962) found that early adopters reaped large profits due to increased corn prices, more production acreage, and the number of years they had planted hybrid seed. Late

adopters did not experience any of the early adopters' benefits. The innovation of hybrid seed, although it did benefit many members of the social system, also widened the socioeconomic gap between wealthy and poor farmers.

Direct and indirect consequences.

Changes in one part of a system usually trigger another series of changes that affects another part of the system. Those changes that result from an immediate response to an innovation are direct consequences. Indirect consequences, as Rogers noted, are "consequences of consequences" (1995, p. 415).

Rogers (1995) used a study by Linton and Kardiner (1952) to illustrate the direct and indirect consequences of innovations. Prior to adopting the innovation of wet rice farming, a nomadic tribe in Madagascar had farmed on dry land. The tribe moved to a new location after each harvest. After converting to wet-land farming and realizing they could harvest rice on a regular basis in the same location, the tribe abandoned its nomadic lifestyle. Soon, the concept of private property evolved. Other consequences of the innovation of wet-land farming included social class differences, changes

in tribal government, the disintegration of the extended clan, and the development of the nuclear family.

Anticipated and unanticipated consequences.

According to Skill (1993), convenience is an anticipated outcome of the computerization of banking. An unanticipated or unexpected consequence of the innovation is a loss of privacy. Skill stated that credit histories have now become part of the "semi-public" (p. 73) domain. Now, individuals and firms in the business sector can easily access information that was once strictly guarded by bankers. Computerization may have enhanced efficiency, but it has also resulted in a loss of privacy for the banking client.

The loss of privacy could be viewed as a dependent variable or consequence of innovativeness. In the future, Rogers (1995) called for diffusion research that treats innovativeness as a predictor of consequences. According to Rogers, past research that focused on variables related to innovativeness stopped after analyzing the decision to adopt an innovation. Rogers suggested that diffusion research should also examine how adoption choices are made and the effects of those

choices.

To ascertain if the pro-innovation assumptions of change agencies are valid, Rogers advocated that researchers conduct in-depth case studies. In the past, diffusion researchers have employed surveys to gather data. As Rogers pointed out, quantifiable measures do make generalizations easier. However, qualitative approaches are more appropriate to the study of consequences of innovation.

According to critics, the emphasis on quantifiable results has led to a stress on quantity and efficiency of production instead of quality of life issues. They contend that the rural sociologist's diffusion model perpetuates the "dominant paradigm of development" (Rogers, 1983, p. 121). This paradigm holds that economic growth, expensive technology, and centralized planning are the keys to the development of a society capable of assuring the well-being of the system and the individual. An alternative paradigm emerged when scholars in the United States and developing nations began to question these assumptions (Bordenave, 1976; Rogers, 1983).

The Emergence of the Alternative Paradigm

The alternative paradigm holds that the well-being of the system and the individual can be assured through equality of distribution, improved life quality, and appropriate technology (Rogers, 1983). Critics of diffusion research based on the rural sociology tradition questioned whether it could accommodate an alternative paradigm of development (Pampel & van Es, 1977). Nowak (1987) argued that non-technological innovations like contour planting be examined from an economic as well as a diffusion perspective. Although Nowak's suggestion does support the alternative paradigm, it still treats the innovation as the key component in diffusion studies.

Innovation-centeredness is inherently inappropriate to the study of contour planting, conservation, sustainable agriculture, and other non-technological innovations. Unlike technological innovations, non-technological innovations cannot be cha cterized according to trialability and observability because their success requires the use of long-term techniques (Cook, 1981; Kiley, 1981; Knorr, 1983). Concepts central to the time element in the innovation-centered rural sociology

model, such as adoption categories and rate of adoption, are difficult to operationalize in studies of non-technological innovations. As Rogers (1983) noted, the individuals who were slow to adopt high-input agricultural practices in the 1950s were classified as laggards. Today, when the focus is on the innovation of low-input or sustainable agriculture, they would be classified as innovators. The meaning of adoption rates is also difficult to operationalize when adoption of the non-technological innovation requires modification (Rogers, 1983). Do farmers adopt sustainable agriculture when they convert part or all of their acreage from high-input to low-input production?

Communication-centered Diffusion Research

However, if diffusion research is communication-centered, it is appropriate to the study of the adoption or rejection of non-technological innovations. By emphasizing the process of communication, the focus shifts from the new idea or innovation to the communication of information and persuasion (Deutschmann & Danielson, 1960; Greenberg, 1964) about non-technological innovations over time among members of a

social system.

In the case of sustainable agriculture, a communication-centered approach to innovation reveals that change agents promoting sustainable agriculture (United States Department of Agriculture, 1991) have suffered a loss of credibility. Farmers perceive that change agents, typically from the Extension Service, represent an agency that has reversed its stance on high-input agriculture (U.S. House of Representatives, 1982). Change agents once encouraged farmers to invest in and adopt pesticides, fertilizers, new varieties of seed, and equipment to increase yields and profits. Now, the same change agents are asking farmers to adopt sustainable agriculture and abandon their investments in high-input agriculture.

A communication-centered approach to diffusion readily demonstrates that the two-step flow of information necessary to convince farmers to adopt (Copp, Sill, & Brown, 1958; Katz, 1957; Lazarsfeld, Berelson, & Gaudet, 1944; 1968) will not occur. In the innovation-centered diffusion model, actual adoption decisions occur after an extension agent suggests an innovation and a

neighbor who has adopted the innovation convinces the farmer to adopt. The farmer who typifies the adopter profile (Rogers, 1995) rightly questions the wisdom of adopting sustainable agriculture and never emerges as an opinion leader.

Another advantage of a communication-centered model of diffusion is its ability to detect what Rogers refers to as a pro-innovation bias (Rogers, 1983). Farmers also recognize this bias, which operates when change agents urge the adoption of an innovation that is being promoted within their own social system. Extension agents might urge the adoption of a new insecticide based on a chemical compound that scientists in a land-grant university or the USDA have discovered. The bias also appears when a change agent urges the adoption of self-propelled combines made by an equipment manufacturer who sponsors grant-funded research. When the focus is on communication instead of the innovation, the failure of change agents' persuasive efforts can be easily predicted.

Although Rogers did not promote the development of a communication-centered model of diffusion, he did come

to regard diffusion as a subfield of communication (1971, with Shoemaker). He titled the second edition of his synthesis of diffusion research Communication of Innovations (1971, with Shoemaker). In the fourth edition of Diffusion of Innovations, Rogers applauded the contribution of communication scholars to diffusion research.

The studies conducted by communication scholars demonstrate that the discipline is well-equipped to develop a model of the communication of innovations that could revolutionize (Kuhn, 1970) diffusion research. As Rogers (1995) noted, "we do not need `more of the same' diffusion research" (p. xvii). A communication-centered approach to diffusion research is an innovation that responds to changing conditions and critical challenges.

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